Composable Modeling and Simulation Workshop

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Global InfoTek, Inc.

Agenda

- GITI Concept

- Agent / Service Framework (CoABS Grid)

- 'Advertising' Agents and Services

- Software for HLA Simulation service

- Composable Planner

- Future and Tough Quesitons Remaining

2

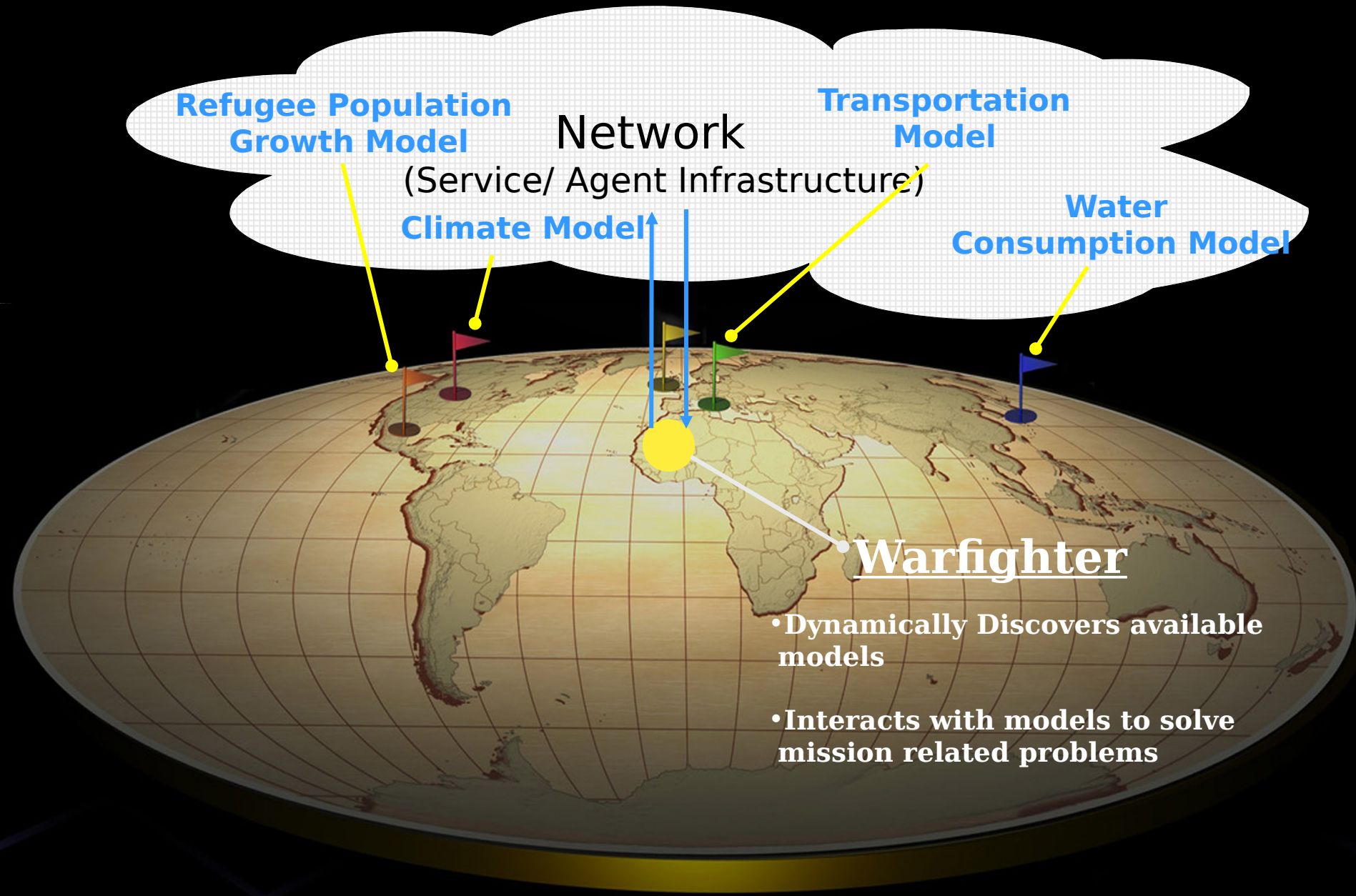Refugee Population Growth Model

Network
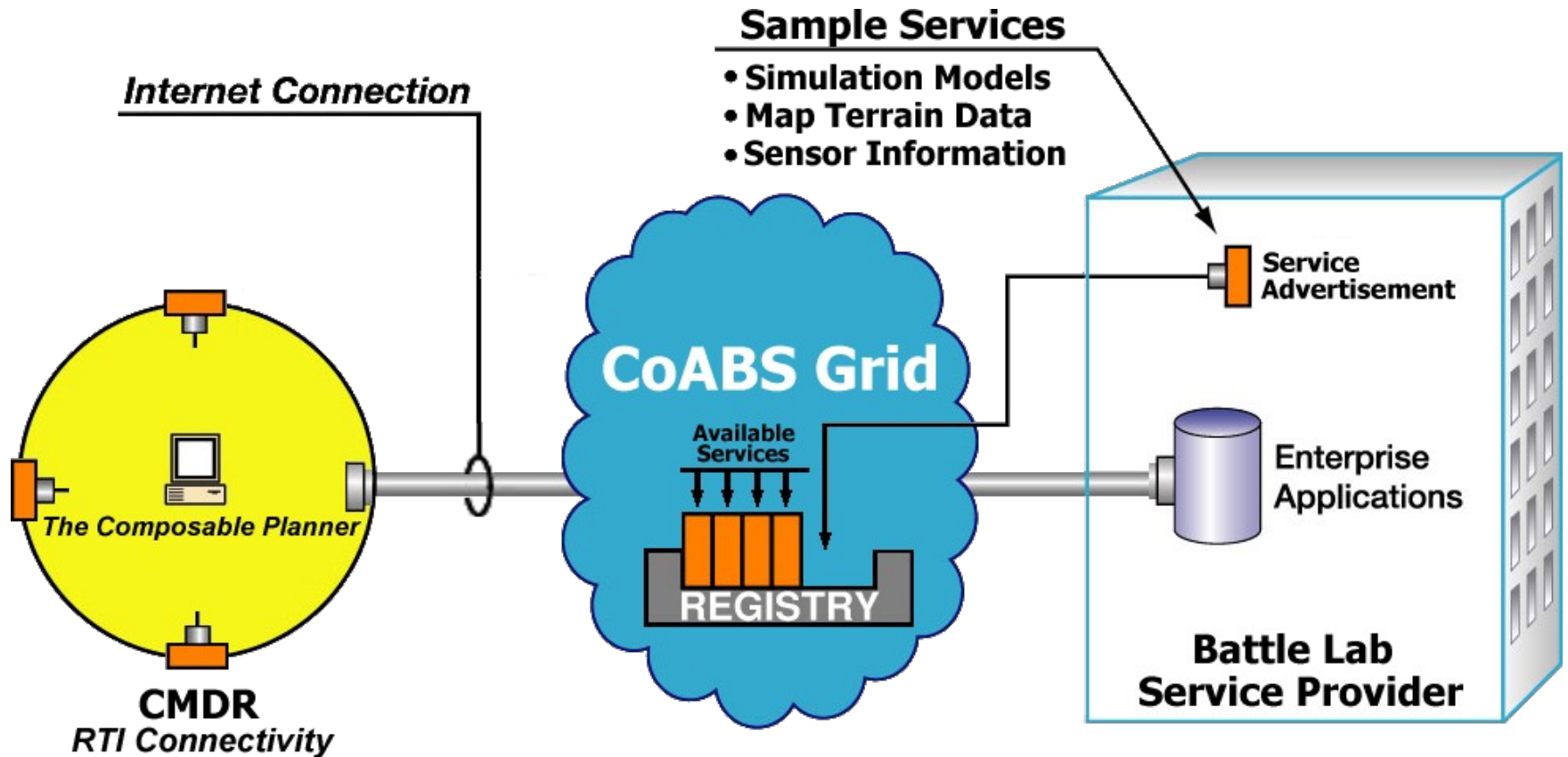(Service/ Agent Infrastructure)

Transportation Model

Climate Model

Water Consumption Model

Warfighter

- Dynamically Discovers available models

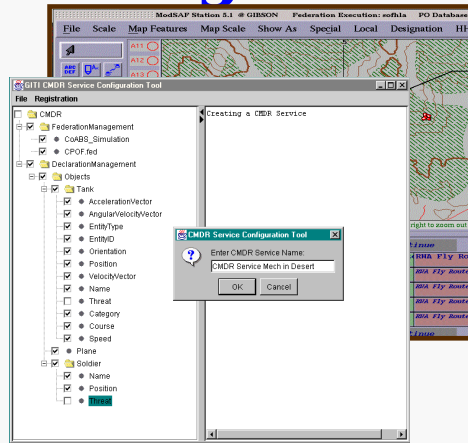- Interacts with models to solve mission related problems

GITI Concept

Internet Connection

Sample Services
- Simulation Models
- Map Terrain Data
- Sensor Information

CoABS Grid

Available Services

REGISTRY

The Composable Planner

CMDR
RTI Connectivity

Service Advertisement

Enterprise Applications

Battle Lab Service Provider

System Components

Simulation Registration

Controller

Service Providers use tool to 'advertise' simulation resources by identifying FOM and meta-data describing tools

Simulation and Advertiser

Configuration

Meta-data

Software

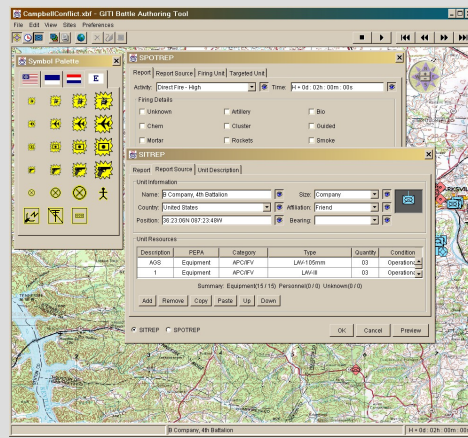*Registration includes meta-data, software plug-in, and configuration information (e.g. RTI.rid, FED file)*

Network (CoABS Grid)

Discovery and Use

User

Users can discover remote services and agents. New capabilities are dynamically added giving the user new features and capabilities

Composable Planner

*Discovery and Query of available services*

Configuration

Software

Planning Tool downloads Software and Configuration Information

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Control of Agent Based Systems (CoA

- Providing a robust and flexible framework for integrating diverse legacy and agent-based systems by dynamically discovering, and connecting systems

- Enabling rapid creation of system of systems for enhancing military operations (planning, command, execution, combat support) and response to changing operations.

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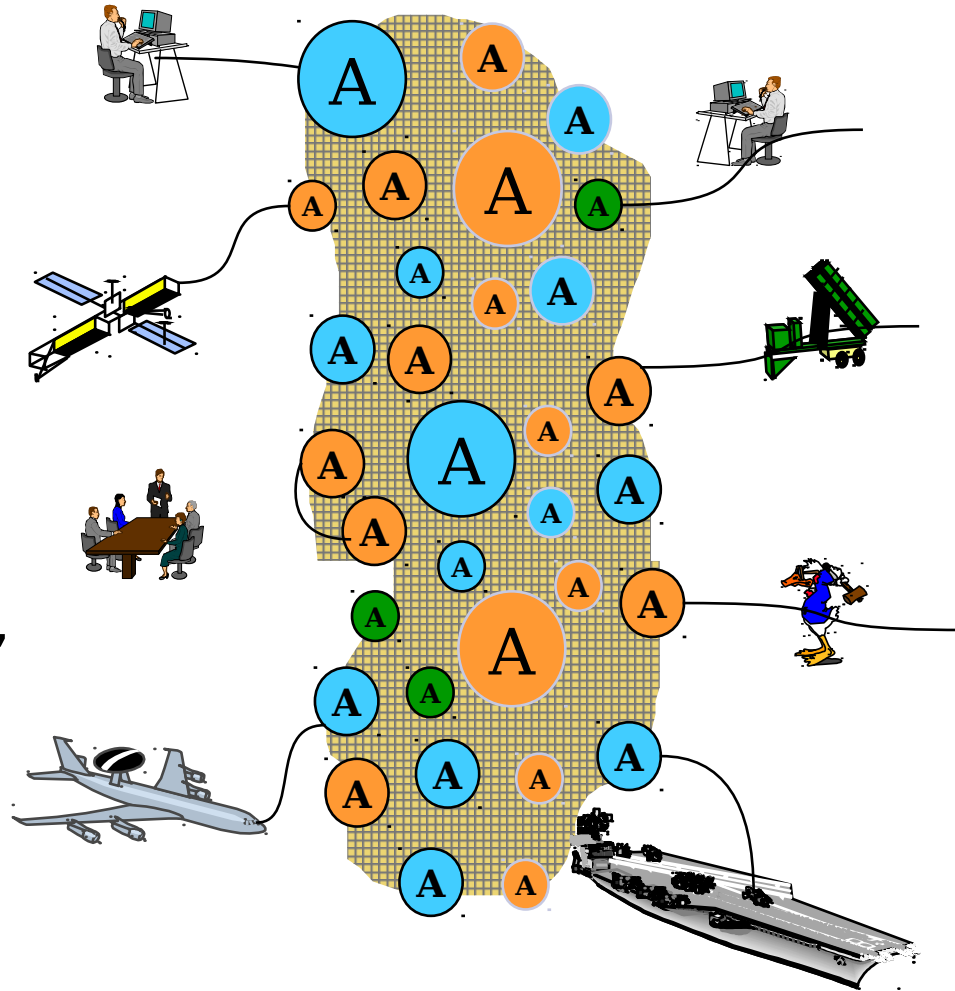
CoABS
Interoperability Hypotheses
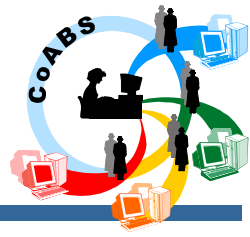
- Large scale systems can be built by the *run-time* integration of heterogeneous systems *(no recoding necessary)*

- Agent-Based System Concepts *facilitate* this integration (provide an appropriate level of abstraction for integration)

- Legacy systems can be "*agentized*" to provide external access and interoperability (key insights can be brought to LAN/WAN software approach)
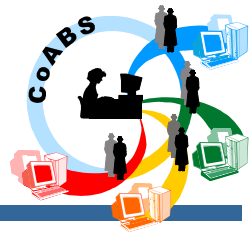
The CoABS Grid
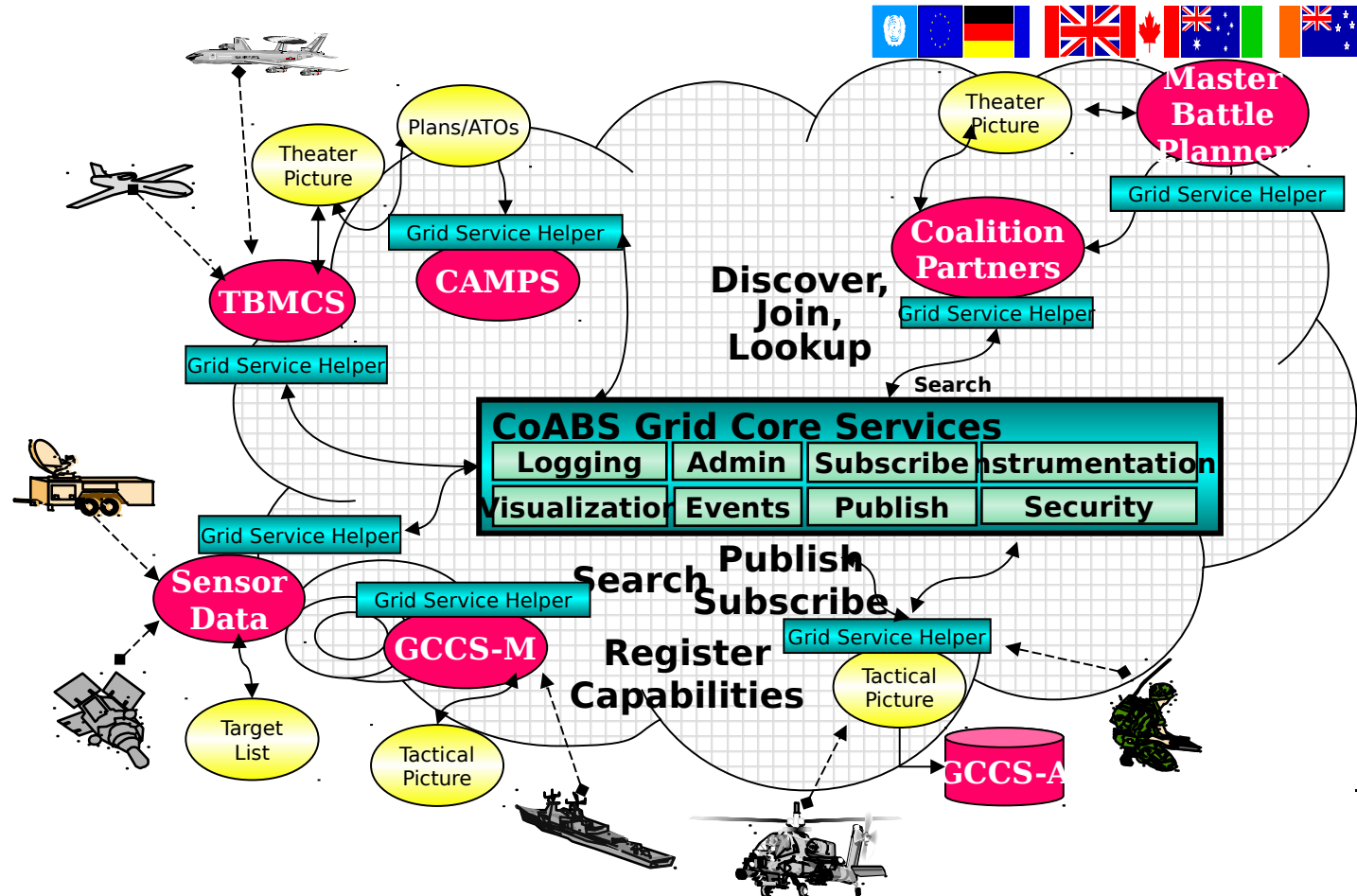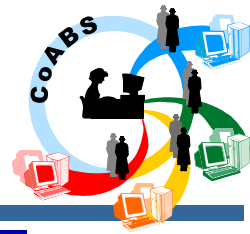
Prototype CoABS Grid allows heterogeneous agent and legacy systems to:

■ **Register themselves & needs**

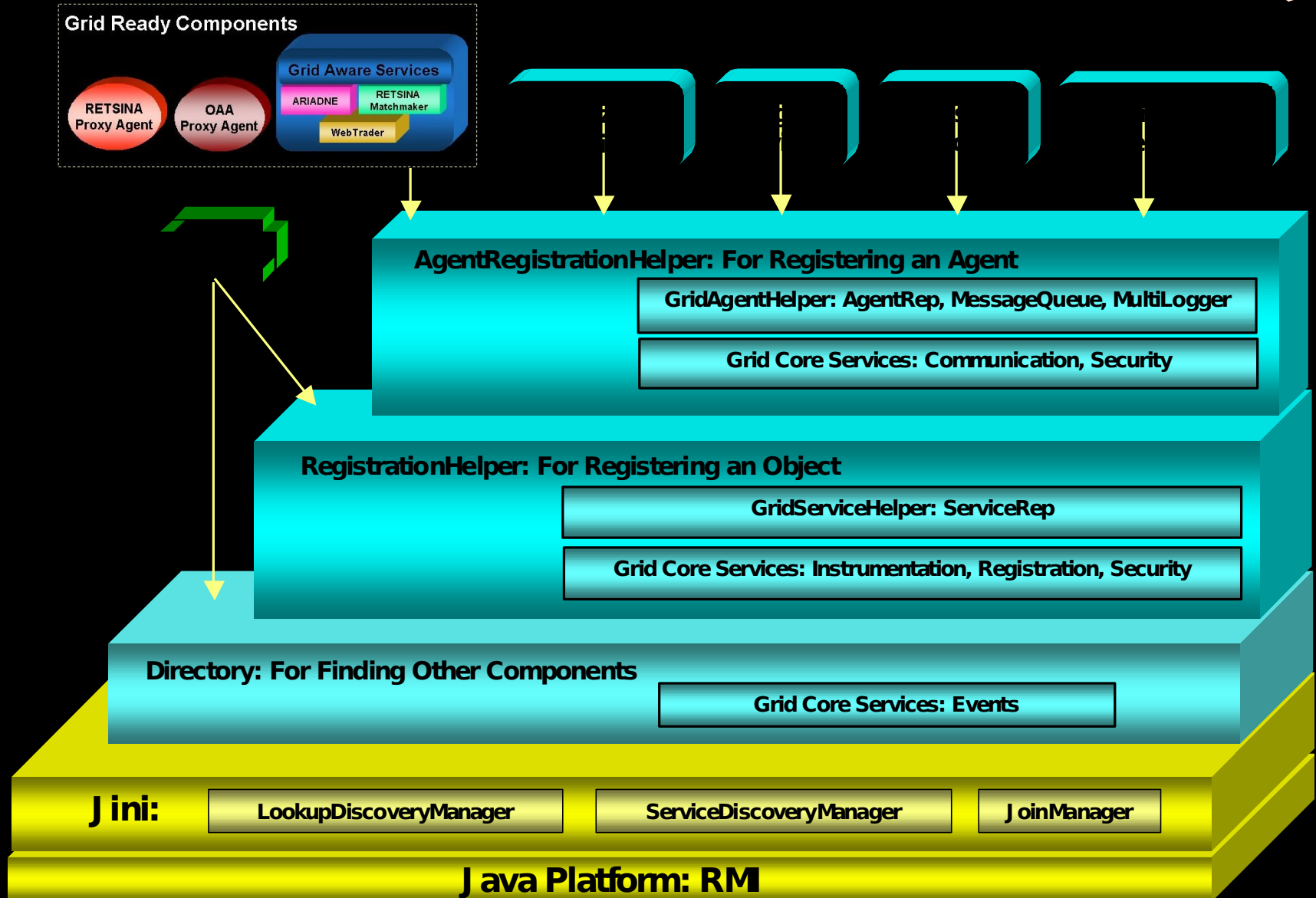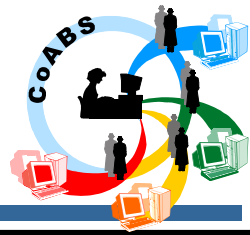■ **Advertise their capabilities**
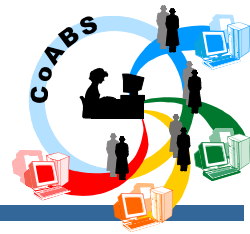
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What does this mean functionally?

- Software components can be wired together quickly with little additional programming – System of systems
  - New technology can be inserted without a major effort
  - Alternative system configurations can be easily tested

- System robustness and continuity of operations
  - When system components become unavailable, substitutes can be dynamically found, integrated and tasked

- Split-based operations support
  - Front-line soldiers can discover and task applications that are being run on distant and more powerful computers
  - Planners, simulations, models, imagery

Framework

Grid Ready Components

Grid Aware Services
- ARIADNE
- RETSINA Matchmaker
- WebTrader

RETSINA Proxy Agent

OAA Proxy Agent

AgentRegistrationHelper: For Registering an Agent

GridAgentHelper: AgentRep, MessageQueue, MultiLogger

Grid Core Services: Communication, Security

RegistrationHelper: For Registering an Object

GridServiceHelper: ServiceRep

Grid Core Services: Instrumentation, Registration, Security

Directory: For Finding Other Components

Grid Core Services: Events

Jini: LookupDiscoveryManager | ServiceDiscoveryManager | JoinManager

**Java Platform: RMI**

CoABS Grid Lookup Experiment

Process

- Two parts to investigation
  - How long does it take to register an agent?
  - How long does it take to look up an agent?
  - When registered population is 500, 1,000, 1,500 …10,000 agents
- Qualitative results
  - 20 machines used, measurements made on client machines
  - Client machine speed, memory, and network latency affect results
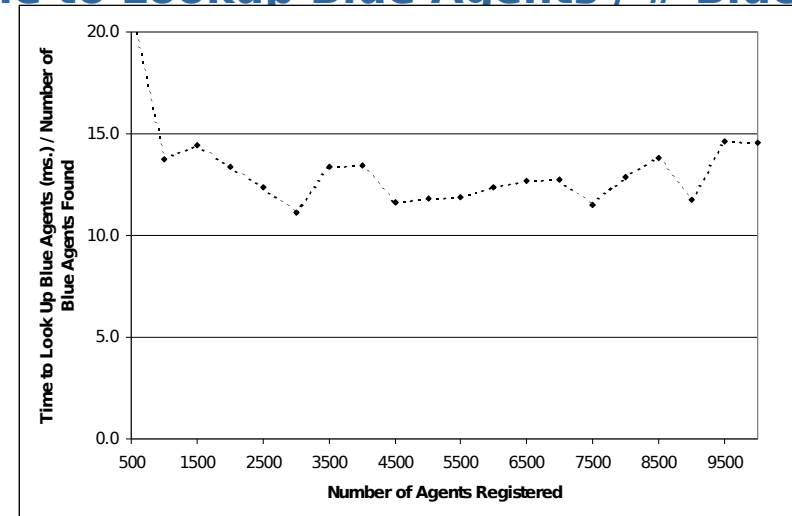
Summary of Experimental Findings

- No degradation in performance with up to 10,000 agents for lookup
- Minimal degradations in performance with up to 10,000 agents for registration
  - Slope approximately 0.0334 ms./agent
- The total number of agents in the lookup service does not substantively contribute to the lookup times for the numbers of agents investigated
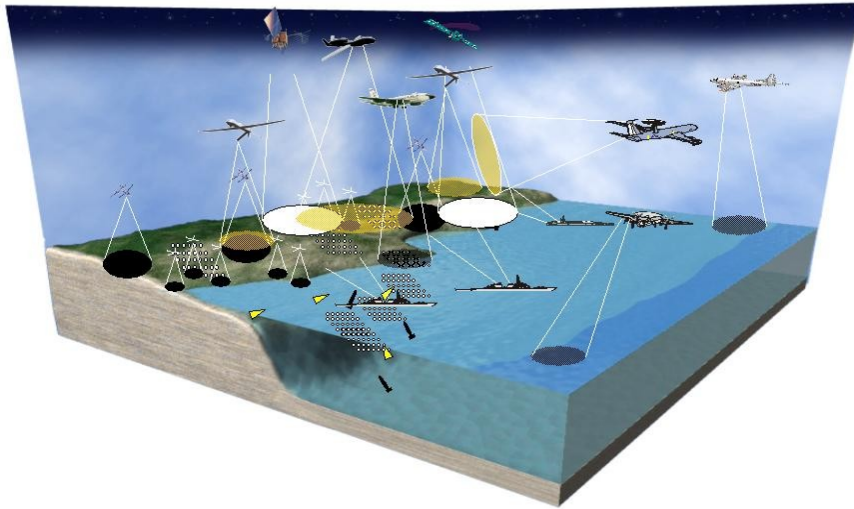
Registration

$y = 0.0334x + 119.08$

Time to Register an Agent vs. Cumulative Number of Agents Registered
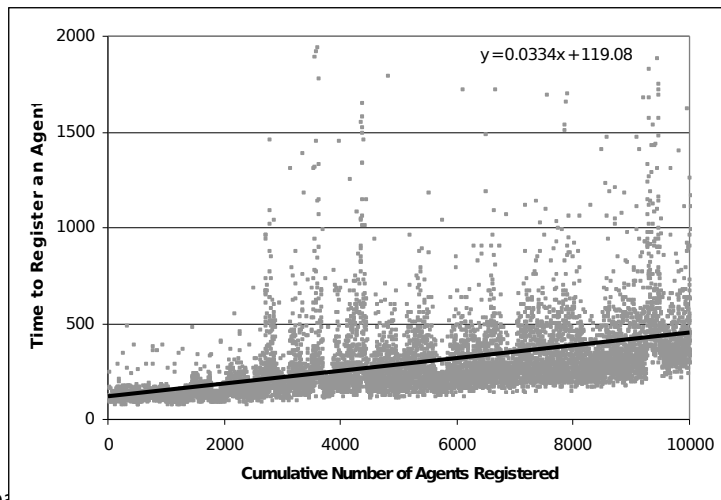
Time to Lookup Blue Agents / # Blue Agents

Time to Look Up Blue Agents (ms.) / Number of Blue Agents Found vs. Number of Agents Registered

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CoABS
Expeditionary Sensor Grid (ESG) Enabling Environments (EEE)

Objectives

- GOAL: How do we implement a flexible and powerful ESG?

- FY01 Mission: INTEGRATE & TEST ABC

- FY02 Mission: INTEGRATE & TEST SENSOR ARCHITECTURES

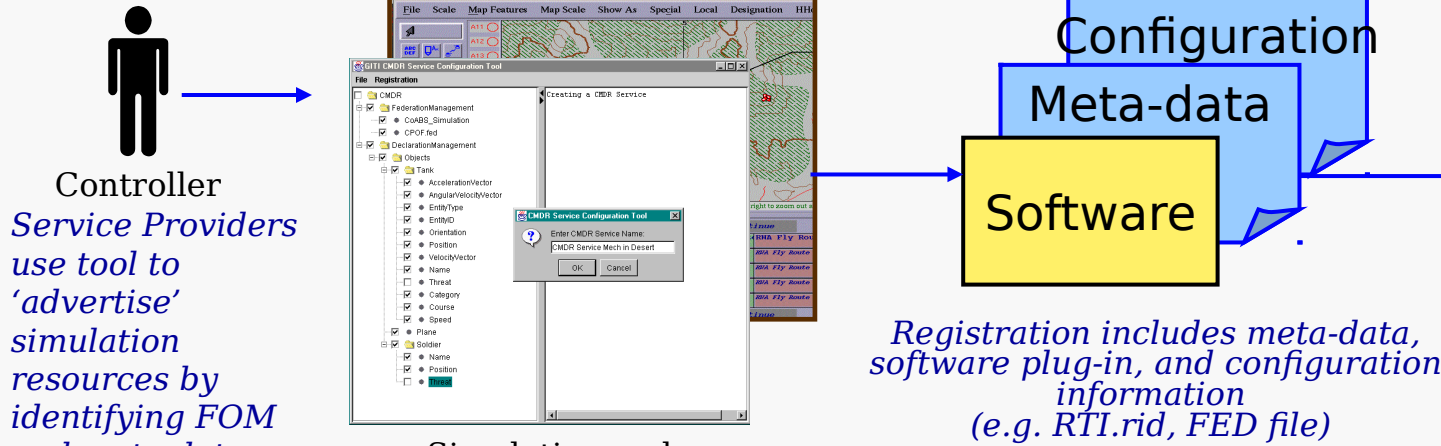- FY03 Mission: INTEGRATE & TEST A PROTOTYPE ESG

Experiments and Testbed

- How do we operate ABC solutions in a secure military environment? Security Testbed

- How do we integrate legacy systems into an ABC Grid environment? Legacy Testbed

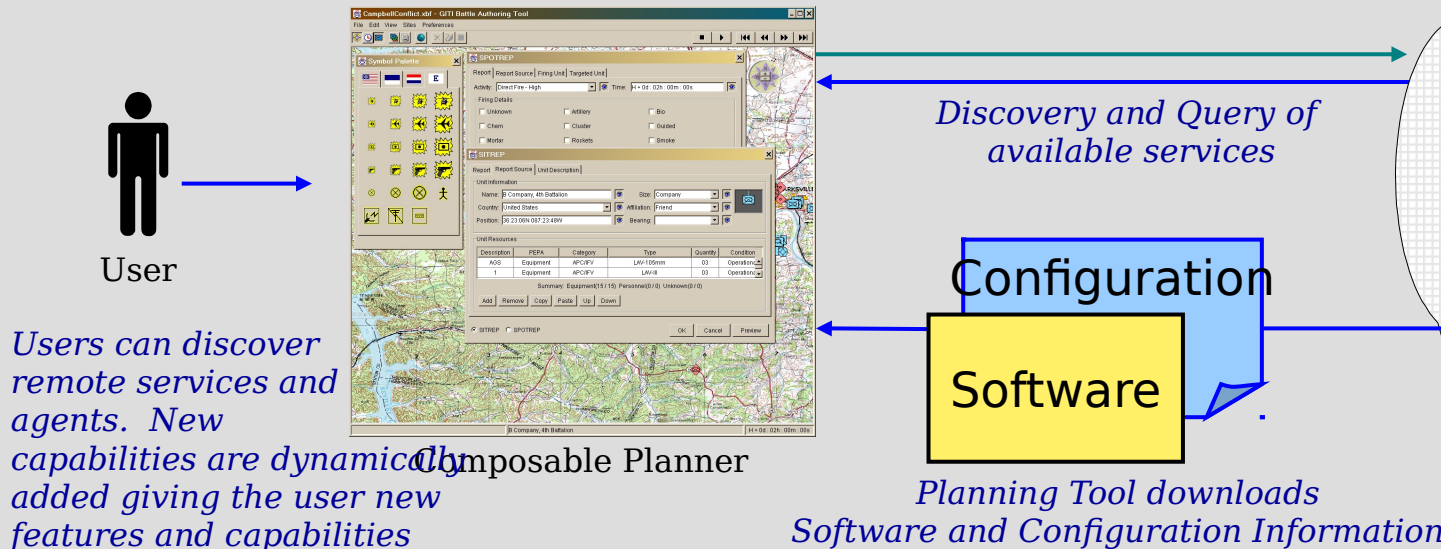- How do we use ABC systems to implement the EEE? Simulation Testbed

Results to date:

- ABC is proving viable and advantageous

- Grid holding up well to stress tests

- Grid-enabling legacy system not difficult

- Lots of security issues, as expected
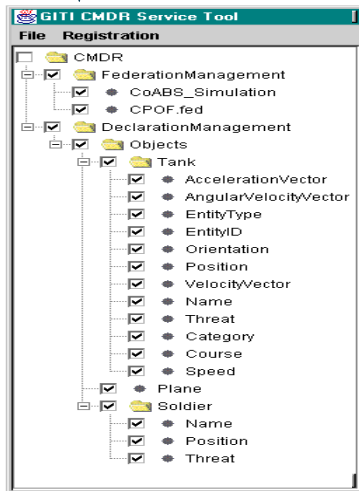
System Components

Simulation Registration

Controller

Service Providers use tool to 'advertise' simulation resources by identifying FOM and meta-data describing tools

Simulation and Advertiser

Configuration

Meta-data

Software

Registration includes meta-data, software plug-in, and configuration information (e.g. RTI.rid, FED file)

Network (CoABS Grid)

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Composable Planner

Discovery and Query of available services

Configuration

Software

Planning Tool downloads Software and Configuration Information

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Registration Process

Designate meta-data entries to advertise

1

Put service entries in CoABS Grid registry

2
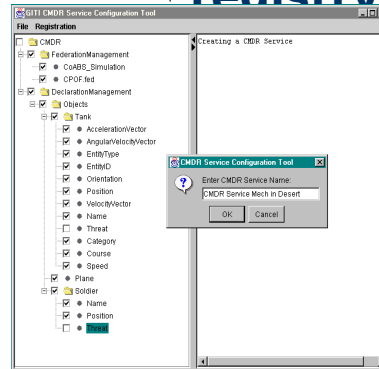
Provide any software for download

3
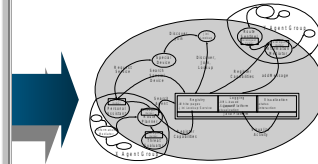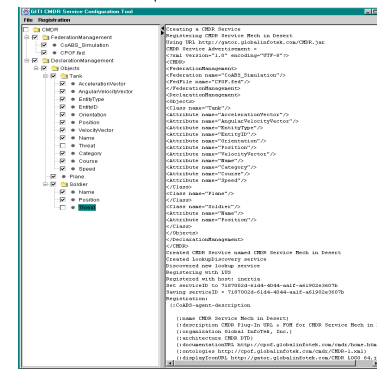
Name
Description
Resources
User Interface
URL to CMDR JAR
Etc.

CMDR JAR

CMDR Service CoABS Registry Descriptor
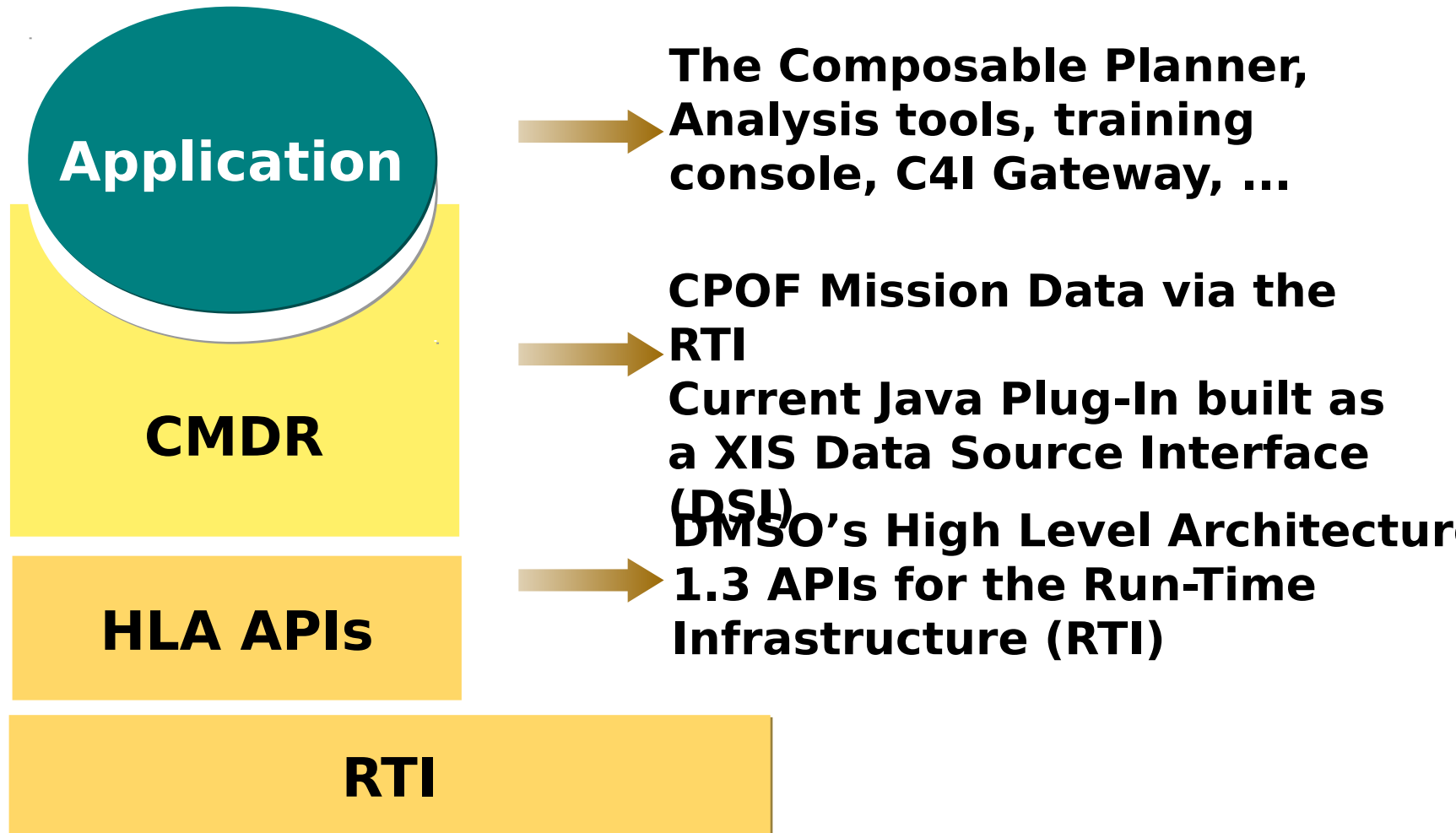
Register

CoABS Grid Registry

CMDR Service

Simulation Advertiser

- Intuitively steps users through process of advertising DIAMOND Simulation on CoABS Grid

- DIAMOND Service accepts scenario input, constructs DIAMOND scenario file, runs simulation, and returns output

- Allow users to invoke computing resources at facilities providing reach-back

- Meta-data describes tool for users and agents to search and discover

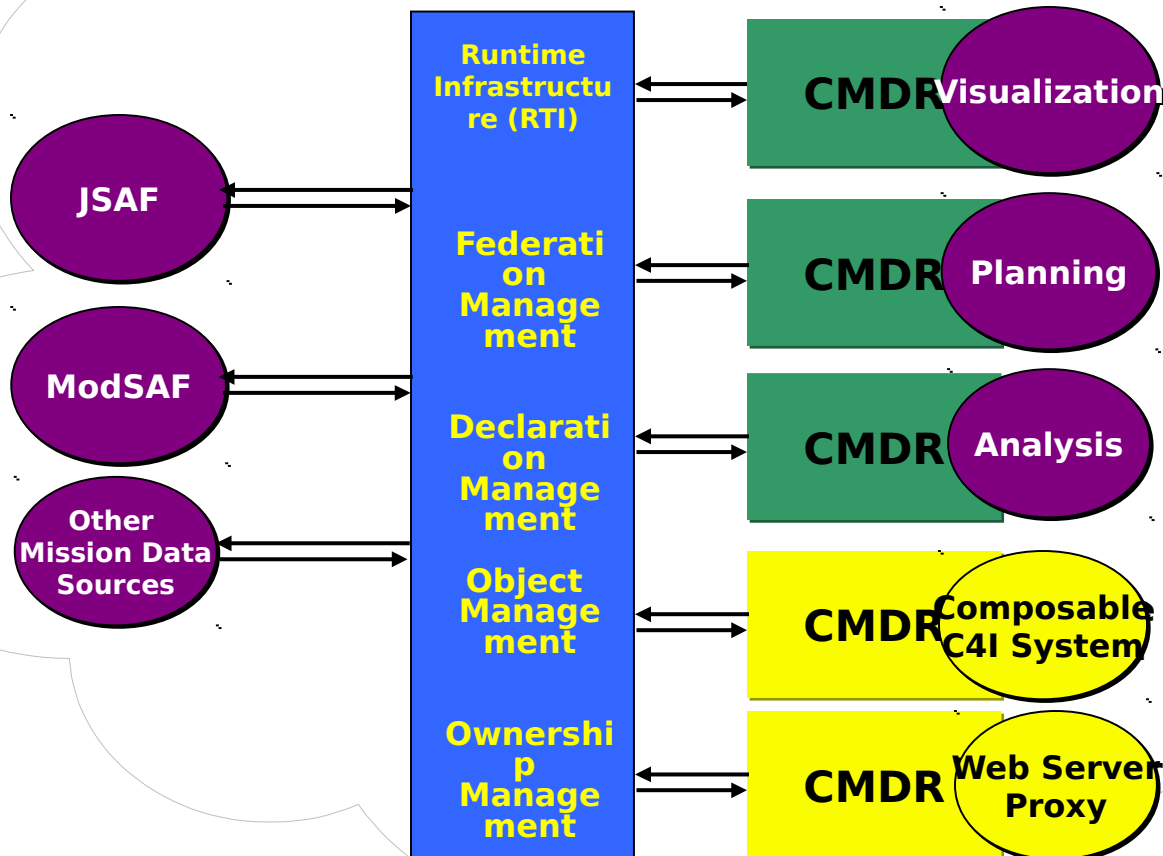- Provides configuration settings and software to

CMDR Architecture

Application

CMDR

HLA APIs

RTI

→ **The Composable Planner, Analysis tools, training console, C4I Gateway, ...**

→ **CPOF Mission Data via the RTI**
Current Java Plug-In built as a XIS Data Source Interface (DSI)

→ **DMSO's High Level Architecture 1.3 APIs for the Run-Time Infrastructure (RTI)**

Leverages existing and diverse simulation applications

Java portability

Internet

CPoF Applications

JSAF

ModSAF

Other Mission Data Sources

Runtime Infrastructure (RTI)

Federation Management

Declaration Management

Object Management

Ownership Management

Logical Time Management

CMDR Visualization

CMDR Planning

CMDR Analysis

CMDR Composable C4I System

CMDR Web Server Proxy

Data distribution across Internet

Easy use and allows for rapid integration

The Composable Planner (The CP)
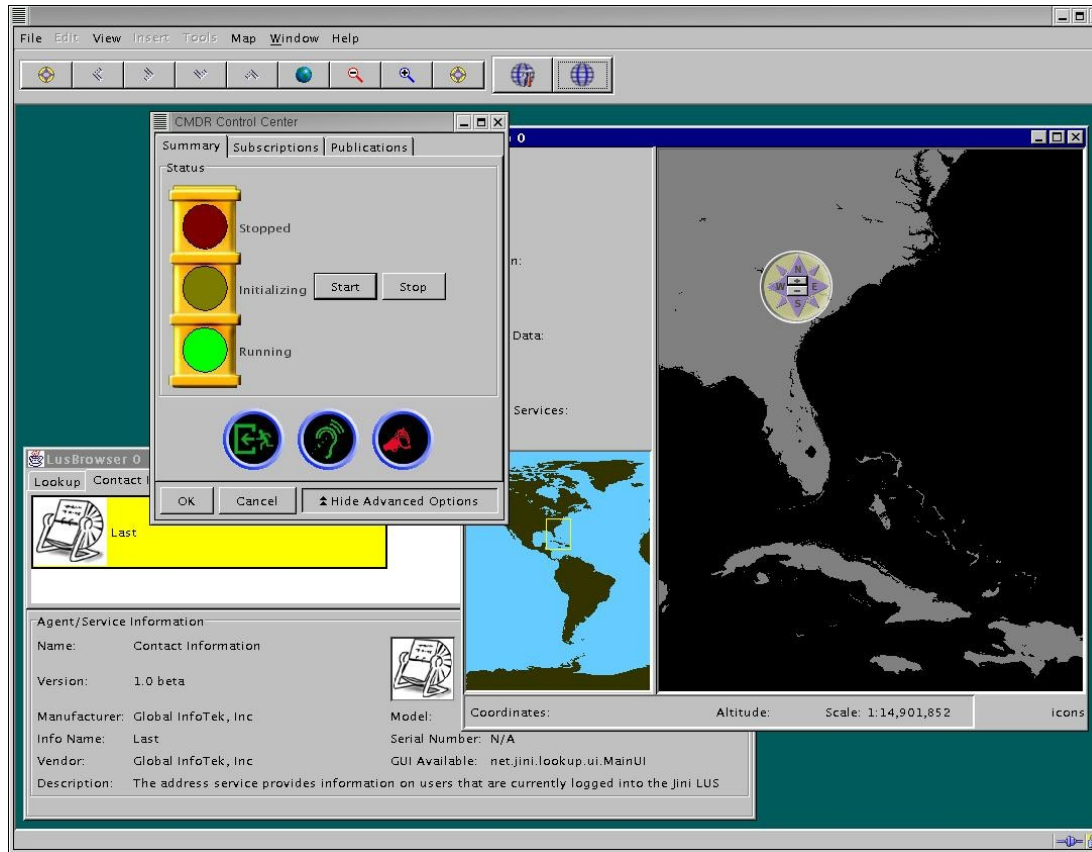
- CoABS Grid 'aware' allowing network and services can be viewed

- GIS Based Planning Tool
  -NIMA data supported

- DMSO's Unit Order of Battle output can be imported

- Deployable through Web Browser

- Uses plug-ins to expand capabilities (e.g. software to become a HLA Federate)

- Drag and Drop discovered agents/services into the workspace

For OOTW, planners can place resources necessary for operations (e.g. refugee camp locations, equipment, personnel and supplies at camps).

After discovering DIAMOND simulation, users can request a simulation run of their C4I data.
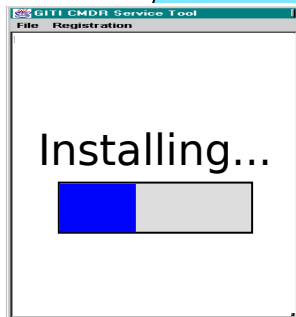
Plug-In Loading Process

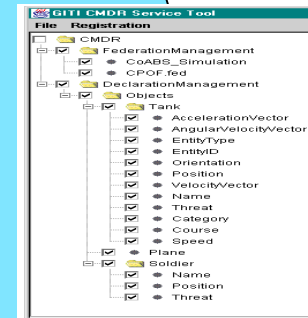**Application installs software and now user can utilize remote simulations**

4
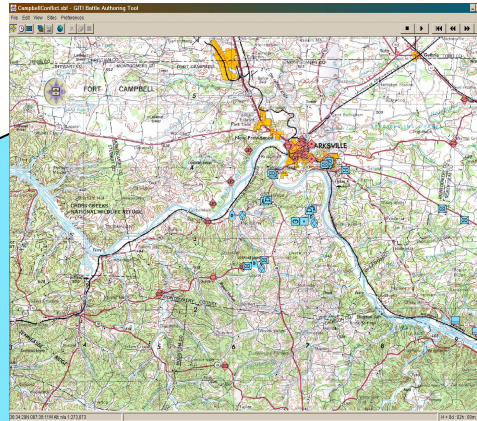
User locates available Simulation Services on network using 'everyday' planning application

1

Installing...

User

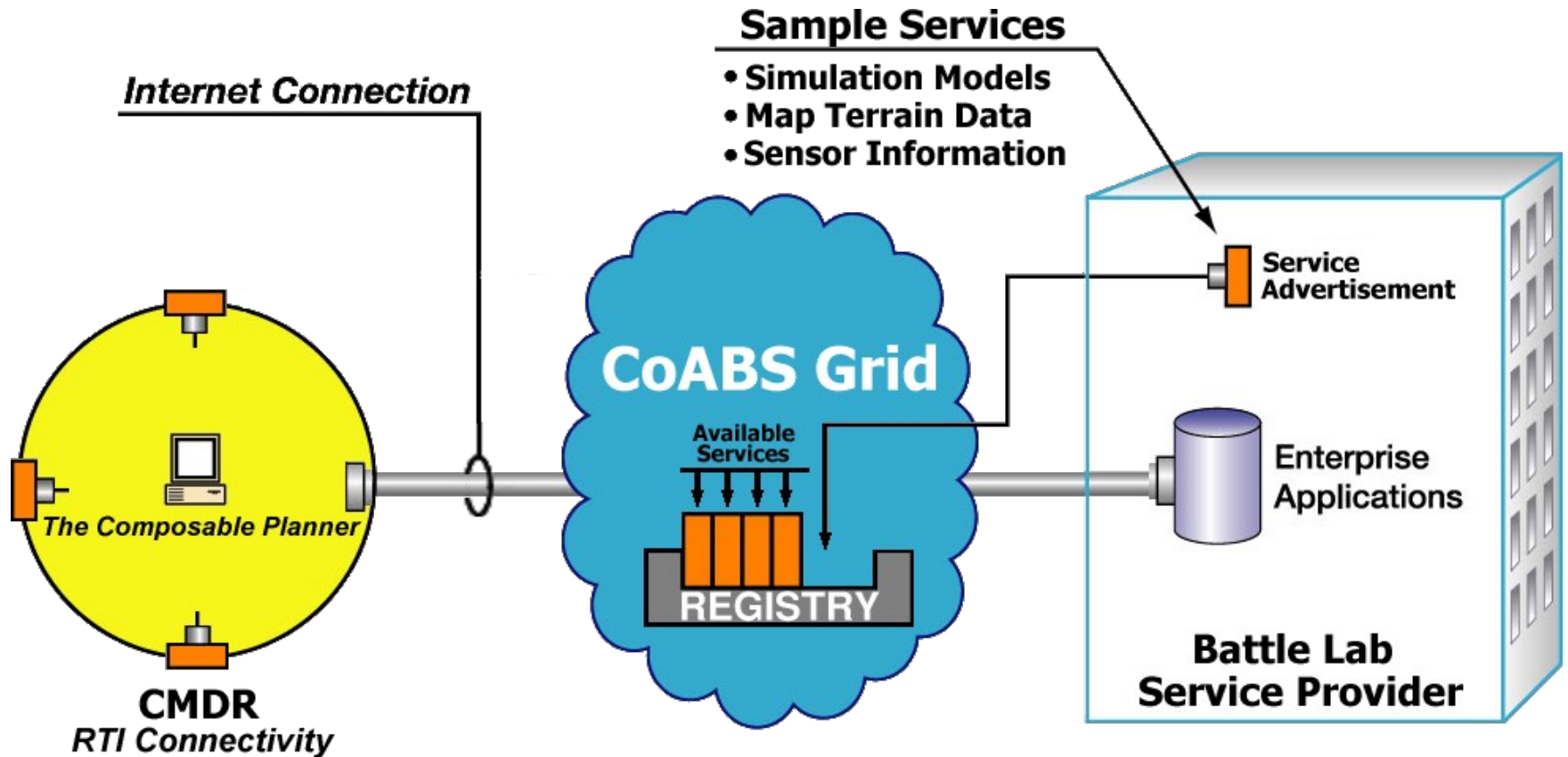Do you have Taliban tanks near Kandahar with position and velocity?

Yes!

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Application downloads CMDR Plug-In and Configuration

2

Query Service to see if service is applicable

Future Concept

Tough Questions

- Ontologies
  - Meta-data advertisement
  - Translations
    - Between differing object models
    - Incomplete data or scale of data (Aggregate vs entity level)
    - Automation of datastream translation

- Configuration data and initial scenario data

- Scalability

- Mobile Code – across different platforms and languages

Additional Slides

Grid Software and Resources

- First Grid alpha release July, 1999,

- Successive releases to present 3.2.2

    - Grid Infrastructure classes

    - Sample code and scripts to run them

    - GridManager and other graphical user interfaces

    - User Manual

    - Jini™ classes and xml parser included to ease installation

    - Available at **http://coabs.globalinfotek.com** for download

Complexity of NEO TIE

- 21 different agent systems and services
- Several distinct agent architectures
  - OAA, Retsina, TEAMCORE
- Distributed development
  - 9+ organizations/sites
- Six implementation languages
  - Java, Lisp, C++, Prolog, Soar, C
- Multiple platforms
  - Windows NT, UNIX Solaris
- Nearly 2000 inter-agent system interactions

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Admin/Management User Interface: Grid Manager

Agent Sequence Visualizer

- Dynamic UML sequence-diagrams used to display agent activity.
- Used to monitor, debug, and demo agent activity.
- Supports live monitoring of other Grid agents (*live* mode), and replay of previously logged sessions (*replay* mode).

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Technology Transition Efforts

- Expeditionary Sensor Grid
- JBI
- EBO
- CECOM
- JIATF-E
- DARPA's Evidence Extraction and Link Discovery – Systems of Systems
- Defense Modeling and Simulation Organization – FOM on Demand
- NRO
- NSA

DARPATech Demo – Airfield Seizure

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JBI – EBO Integration

EBO provides Strategy Development, Campaign Assessment and Scheduling tools

GIE provides Information Assurance capabilities within JBI

JBI provides Core Services (PUB/SUB), Fuselets

- BDA

ISR BM GA/DP&E Shared

Campaign Assessment Tool

VOI (Value of Information)

Represent Resource Constraints

SDT

Joint Targeting Toolkit

Air Campaign Scheduler

Air Operations DB

- **Intel Prep of the Battlespace**
- **Single-INT fusion**
- **MTI Movement for CSAR**

MIDB

Execution

- **Information update**
- **Indications & Warning**

1. A high-level mission is nominated, e.g. "Deny Access"
2. The Joint Targeting Toolkit nominates specific targets which are sent to both the Air Campaign Scheduler and the Campaign Assessment Tool
3. Resource constraints and operational

JBI - EBO Integration: Pub/Sub/.net

Joint Targeting Toolkit (Pseudo)

sub

pub

pub

sub

Campaign Assessment Tool

sub

COM

COM

7 – Publishes Schedule

Air Campaign Scheduler

File Edit Scheduling Views

Dynamic Mission Allocation Planner

OZONE Scheduling Framework
Carnegie Mellon

Post All Attacks

Pub/Sub

.net

com

Java publish

Java subscribe

WDSL

SOAP

CAT

Scheduler

JBI Pub/Sub Target Folder Proof-of-Concept Demonstration

1

Mission Planner

pub | **sub**

Weather

pub

Bomb Damage Assessment

pub | **sub**

1

LUS

Mission

Weather

BDA

2

3

sub

sub

Target Folder

BDA

1 –Components register as publishers on to the Grid.
2. The Target Folder subscribes to Mission and Weather.
3. The BDA folder subscribes to Mission and BDA.

4 - Mission is published – both Target Folder and BDA receive this. As weather is published, only the Target Folder receives the weather data.
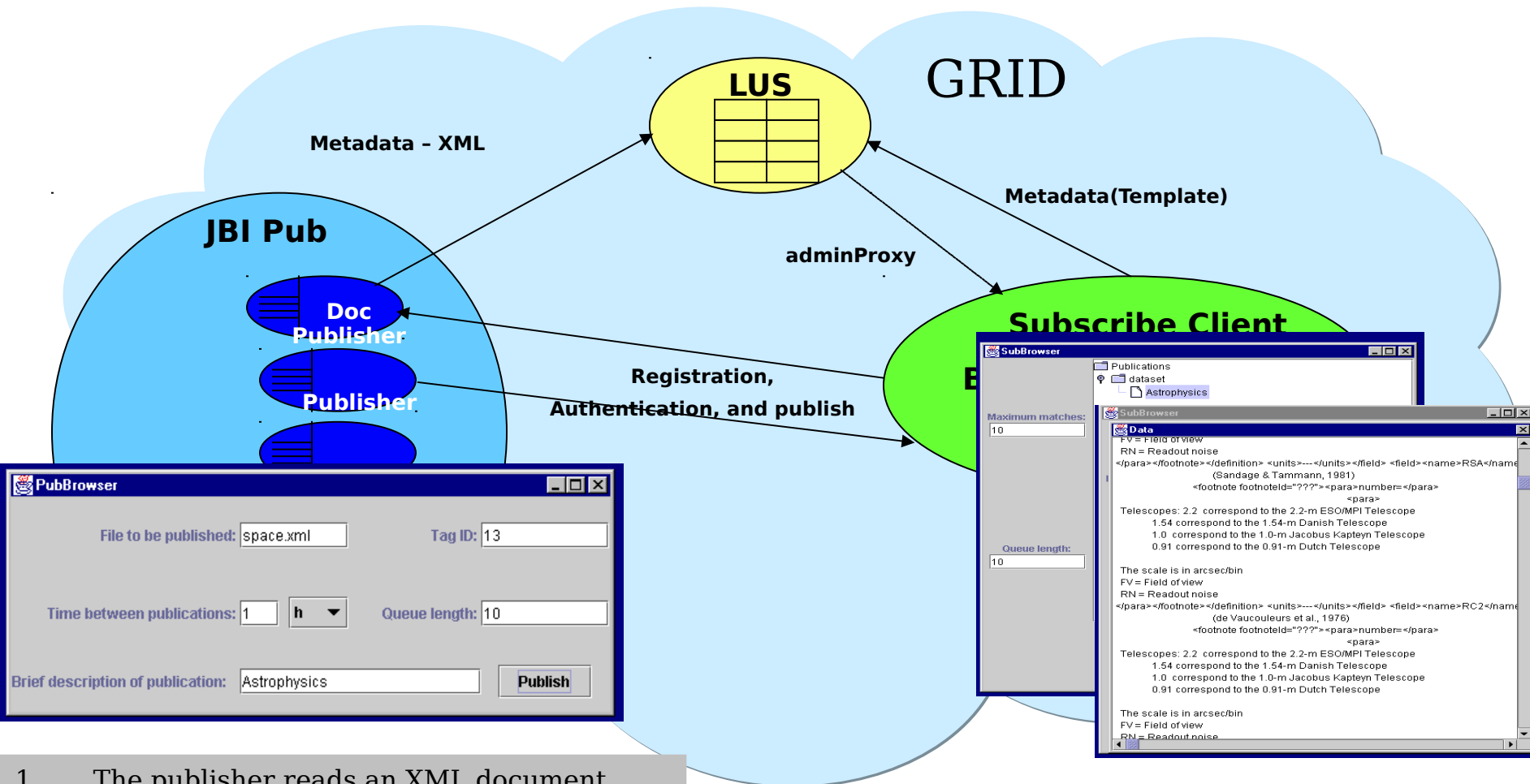5 - The mission takes place.
6 - The BDA observes that a bridge is not taken out and
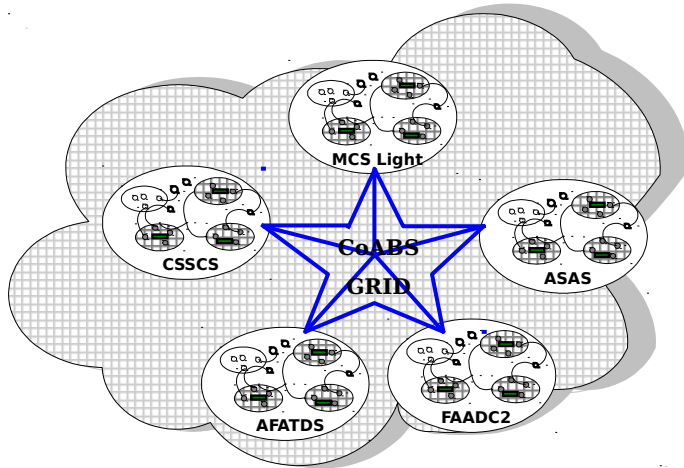
GITI
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An XML Pub/Sub Interface

1. The publisher reads an XML document, parses it, and allows the user to publish information at any level within the Document Object Model
2. A client subscribe to elements within the DOM
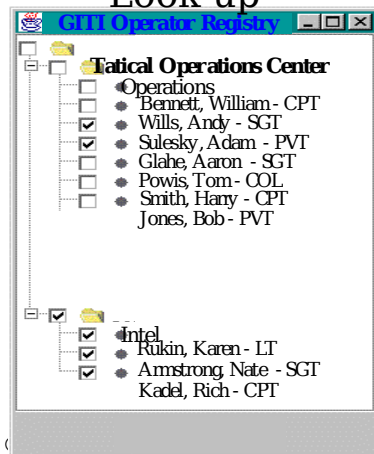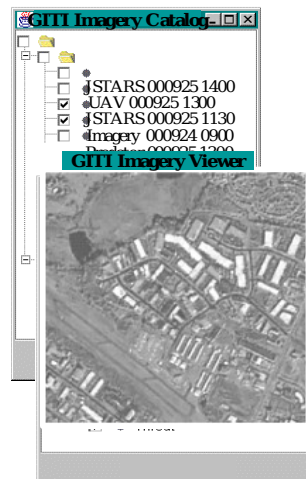
CoABS
Grid Prototype at CECOM

Objectives

- Deploy CoABS Grid at CECOM

- Make MCS-Lite Grid aware, capable of discovering registered Grid services

- Design and create an MCS-Lite Grid standalone access application that is capable of passing data between Grid aware applications and MCS-Lite utilities

Prototypes

Operator Register and Look-up

Imagery Registration and

Results

- The prototype CoABS Grid has been transitioned to CECOM – Agile Commander

- Distributed Event Monitoring is being developed that uses Grid

- The construction of Grid/MCS-enabled apps that provide:

  - The capability to register MCS users on the Grid and view current MCS users

  - Catalog and Viewer Services for Imagery

DARPA CoABS Grid Deliverables Schedule

Capabilities

- ServiceUI Browser
- Pub/Sub service

- CoABS community extensions release

- CoABS community extensions release

- Incorporation of new Jini™ security architecture
- Improve support for internet/firewalls

- AgentRepUI Enhancements
- GridManager Enhancements

- Computer assisted code generation for legacy system wrapping
- Predicate-based lookup

Timeline:

| 12 | 25 | 29 | 18 | 8 | 29 | 30 |

| Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct |

Release 3.2 — Release 3.3 — Release 3.3 ext — Release 4.0alpha — Release4.0beta — Release 3.4 ext — Release 4.0 Final

Impacts

- GUI associated with Grid agents and services can be downloaded so that user can directly interact with them.
- Manage information by exception – automatic and timely delivery of information

- Increased ease-of-use for programmer
- Significantly improve use and management of the Grid by non programmers

- Grid aware agents and services for general use and packaged for ease of use

- Create wrappers within minutes
- Allow complex search queries against LUS with improved bandwidth utilization - potentially savings of up to 70%

- Grid aware agents and services for general use and packaged for ease of use

- Message integrity, confidentiality, and mutual authentication of participating parties